

IN THE TITLE:

Please amend the Title of the Application to as follows:

“Spatial Separation and Multi-Polarization of Antennae in a Wireless Cellular Network”

IN THE DRAWINGS

Please amend Figures 1 and 9 in accordance with the marked-up drawing sheets attached hereto.

IN THE SPECIFICATION

Please amend the specification as follows:

- Please amend the paragraph beginning at line 16 on page 19 as follows:

Figure 6a is a plot of the singular values (averaged across small scale fades) versus time for the system of Figure 4 that includes spatially separate antennae having the same polarization states and a K-factor of 6 dB. The system of Figure 4 includes two transmitter antennae and three receiver antennae. Therefore the channel matrix H has two singular values. The first singular value 605 has an average value of about 7.5 dB relative to a normalized reference. The second singular value 610 has an average value of about -12.5 dB. Therefore, the resulting singular value spread is about $7.5 + 12.5 = 20$ dB.

- Please amend the paragraph beginning at line 3 of page 20 as follows:

Figure 6b is a plot of the singular values versus time for the system of Figure 5 that includes spatially separate antennae having the different polarization states and a K-factor of 6 dB. Again, the channel matrix H has two singular

values. The first singular value 615 has an average value of about 5 dB. The second singular value 620 has an average value of about -5 dB. Therefore, the resulting singular value spread is about $5 + 5 = 10$ dB. The system of Figure 5 provides a singular value spread that is 10 dB less than the singular value spread of the system of Figure 4, and therefore, has a better noise enhancement performance.

- Please amend the paragraph beginning with line 11 of page 20 as follows:

Figure 6c is a plot that shows the capacity of the systems of Figure 4 and Figure 5 with a K-factor of 6 dB. As shown in Figure 6c, the capacity of the system of Figure 5 (denoted with line 635) is greater than the capacity of the system of Figure 4 (line 630). The probability axis indicates the probability that a receiver can receive information at the specified capacity or less. The capacity axis indicates the capacity of the channel for the specified antenna polarization settings.

- Please amend the paragraph beginning with line 17 of page 20 as follows:

Figure 7a is a plot of the singular values versus time for the system of Figure 4 that includes spatially separate antennae having the same polarization states and a K-factor of 10 dB. Again, the channel matrix H has two singular values. The first singular value 705 has an average value of about 7.5 dB relative to a normalized reference. The second singular value 710 has an average value of about -15 dB. Therefore, the resulting singular value spread is about $7.5 + 12.5 = 22.5$ dB.

- Please amend the paragraph beginning at line 1 of page 21 as follows

Figure 7b is a plot of the singular values versus time for the system of Figure 5 that includes spatially separate antennae having the different polarization states and a K-factor of 10 dB. Again, the channel matrix H has two singular values. The first singular value 715 has an average value of about 4 dB. The second singular value 720 has an average value of about -4 dB. Therefore, the resulting singular value spread is about $5 + 5 = 8$ dB. The system of Figure 5 provides a singular value spread that is 14.5 dB less than the singular value spread of the system of Figure 4.

- Please amend the paragraph beginning with line 8 of page 21 as follows:

Figure 7c is a plot that shows the capacity of the systems of Figure 4 and Figure 5 with a K-factor of ~~6~~ 10 dB. As shown in Figure 7c, the capacity of the system of Figure 5 (denoted with line 735) is greater than the capacity of the system of Figure 4 (line 730). The probability axis indicates the probability that a receiver can receive information at the specified capacity or less. The capacity axis indicates the capacity of the channel for the specified antenna polarization settings.

PENDING CLAIMS:

The currently pending claims, as originally filed, are provided as follows:

- 1 1. (Currently Amended) A wireless communication system comprising:
- 2 a plurality of spatially separate transceiver antennae to transmit a corresponding
- 3 plurality of data streams comprising a communication channel to a remote receiver
- 4 having a plurality of receiver antennae, each transceiver spatially separate from at least
- 5 ~~one other transceiver antenna, each transceiver antenna further comprising a transceiver~~

antenna polarization, at least one transceiver antenna having a polarization that is
different than at least one other transceiver antenna, ~~each transceiver antenna transmitting~~
~~a corresponding data stream;~~
~~a plurality of receiver antennae, the receiver antennae receiving at least one data~~
~~stream;~~ wherein
the communication channel between the transceiver antennae and the receiver
antennae is characterized by a channel matrix, and wherein the transceiver antenna
polarization of each transceiver antenna is ~~pre-set to optimize~~ determined by reducing a
measure of a singular value spread of the channel matrix to improve a separability of the
received data streams.

2. (Currently Amended) The wireless communication system of claim 1, wherein
the ~~pre-set~~ transceiver antenna polarization of each transceiver antenna is determined
experimentally.

3. (Currently Amended) The wireless communication system of claim 2, wherein
the ~~pre-set~~ transceiver antenna polarization of each transceiver antenna is experimentally
determined by characterizing the separability of received data streams.

4. ***Please cancel claim 4, without prejudice.***

5. (Original) The wireless communication system of claim 1, wherein each receiver
antenna is spatially separate from at least one other receiver antenna, each receiver

3 antenna further comprising a receiver antenna polarization, at least one receiver antenna
4 having a polarization that is different than at least one other receiver antenna.

1 6. (Currently Amended) The wireless communication system of claim 1, further
2 comprising a receiver that is connected to the receiver antenna, the receiver including
3 electronic circuitry for estimating a the channel matrix that represents a the transmission
4 channel between the transceiver antennae and the receiver antennae, the ~~pre-set~~
5 transceiver antenna polarization of each transceiver antenna being determined by
6 ~~minimizing a~~ reducing the measure of the singular value spread of the channel matrix.

1 7. (Currently Amended) The wireless communication system of claim 5, wherein
2 the receiver antenna polarization of each receiver antenna is ~~pre-set~~set to optimize
3 separability of the received data streams.

1 8. (Currently Amended) The wireless communication system of claim 7, wherein
2 the ~~pre-set~~ receiver antenna polarization of each receiver antenna is determined
3 experimentally.

1 9. ***Please cancel claim 9, without prejudice.***

1 10. (Original) The wireless communication system of claim 1, wherein the transceiver
2 antenna polarization of each transceiver antenna is pre-set to minimize correlation
3 between the data streams.

1 11. (Original) The wireless communication system of claim 10, wherein the pre-set
2 transceiver antenna polarization of each transceiver antenna is determined
3 experimentally.

1 12. (Original) The wireless communication system of claim 11, wherein a transmission
2 channel between the transceiver antennae and the receiver antennae is estimated with a
3 channel matrix, and wherein the pre-set transceiver antenna polarization of each
4 transceiver antenna is experimentally determined by minimizing a correlation coefficient
5 of the channel matrix.

1 13. (Original) The wireless communication system of claim 5, wherein the receiver
2 antenna polarization of each receiver antenna is pre-set to minimize correlation between
3 the data streams.

1 14. (Original) The wireless communication system of claim 13, wherein the pre-set
2 receiver antenna polarization of each receiver antenna is determined experimentally.

1 15. (Original) The wireless communication system of claim 14, wherein a transmission
2 channel between the transceiver antennae and the receiver antennae is estimated with a
3 channel matrix, and wherein the pre-set receiver antenna polarization of each receiver
4 antenna is experimentally determined by minimizing a correlation coefficient of the
5 channel matrix.

1 16. (Original) The wireless communication system of claim 1, further comprising
2 clusters of transceiver antennae, each cluster including a transmission channel, wherein
3 the pre-set transceiver antenna polarization of each transceiver antenna is experimentally
4 determined by minimizing co-channel interference between the clusters.

1 17. (Currently Amended) A wireless communication system comprising:
2 a plurality of spatially separate transceiver antennae to transmit a corresponding
3 plurality of data streams comprising a communication channel to a remote receiver
4 having a plurality of receiver antennae, each transceiver spatially separate from at least
5 ~~one other transceiver antenna~~, each transceiver antenna further comprising a transceiver
6 antenna polarization, at least one transceiver antenna having a polarization that is
7 different than at least one other transceiver antenna, ~~each transceiver antenna transmitting~~
8 ~~a corresponding data stream;~~
9 a plurality of receiver antennae, ~~the receiver antennae receiving at least one data~~
10 ~~stream;~~ wherein
11 the communication channel between the transceiver antennae and the receiver
12 antennae is characterized by a channel matrix, and wherein the transceiver antenna
13 polarization of each transceiver antenna is adaptively set to ~~optimize~~ reduce a measure of
14 singular value spread of the channel matrix ~~separability of the received data streams base~~
15 ~~on channel parameters determined within a receiver connected to the receiver antennae.~~

1 18. (Currently Amended) The wireless communication system of claim 17, wherein
2 the receiver includes electronic circuitry for estimating a the channel matrix that represent
3 a transmission channel between the transceiver antennae and the receiver antennae, the
4 transceiver antenna polarization of each transceiver antenna being adaptively set by
5 minimizing a the singular value spread of the channel matrix.

1 19. (Original) A method of wirelessly communicating between a transceiver and a
2 receiver within a wireless communication system, the communication system comprising
3 the transceiver, the transceiver comprising a plurality of transceiver antennae, each
4 transceiver spatially separate from at least one other transceiver antenna, each transceiver
5 antenna further comprising a transceiver antenna polarization, at least one transceiver
6 antenna having a polarization that is different than at least one other transceiver antenna,
7 the communication system further comprising the receiver, the receiver comprising a
8 plurality of receiver antennae, the method comprising:

9 each transceiver antenna transmitting a corresponding data stream;
10 the receiver antennae receiving at least one data stream;

11 electronic circuitry within the receiver estimating a channel matrix that represents
12 a transmission channel between the transceiver antennae and the receiver antennae; and
13 pre-setting the transceiver antenna polarization of each transceiver antenna by
14 minimizing a singular value spread of the channel matrix.

1 20. (Original) The method of wirelessly communicating between a transceiver and a
2 receiver within a wireless communication system of claim 19, wherein each receiver

3 antenna is spatially separate from at least one other receiver antenna, each receiver
4 antenna further comprising a receiver antenna polarization, at least one receiver antenna
5 having a polarization that is different than at least one other receiver antenna, the method
6 further comprising:
7 pre-setting the receiver antenna polarization of each receiver antenna by
8 minimizing a singular value spread of the channel matrix.

1 21. (Original) The method of wirelessly communicating between a transceiver and a
2 receiver within a wireless communication system of claim 19, the method comprising:
3 pre-setting the transceiver antenna polarization of each transceiver antenna to
4 minimize correlation between the data streams.

1 22. (Original) The method of wirelessly communicating between a transceiver and a
2 receiver within a wireless communication system of claim 20, the method comprising:
3 pre-setting the receiver antenna polarization of each receiver antenna to minimize
4 correlation between the data streams.

1 23. (Currently Amended) A wireless communication system comprising:
2 ~~a plurality of transceiver antennae, each transceiver spatially separate from at least~~
3 ~~one other transceiver antenna, each transceiver antenna further comprising a transceiver~~
4 ~~antenna polarization, at least one transceiver antenna having a polarization that is~~
5 ~~different than at least one other transceiver antenna, each transceiver antenna transmitting~~
6 ~~a corresponding data stream;~~

7 ~~a plurality of a receiver, including one or more receiver antennae, the receiver~~
8 antennae receiving at least one data stream from a remote transmitter having a plurality of
9 transceiver antennae, at least one transceiver antenna having a polarization that is
10 different from at least one other transceiver antenna, each transceiver antenna
11 corresponding an associated data stream; and
12 means for setting the transceiver antenna polarization of each transceiver antenna
13 to reduce a measure of singular value spread of a channel matrix representation of a
14 transmission channel including at least a subset of the data streams between the
15 transceiver antennae and the one or more receiver antennae ~~optimize separability of the~~
16 ~~received data streams.~~

1 24. *Please cancel claim 24 without prejudice.*

1 25. (Original) The wireless communication system of claim 23, wherein each receiver
2 antenna is spatially separate from at least one other receiver antenna, each receiver
3 antenna further comprising a receiver antenna polarization, at least one receiver antenna
4 having a polarization that is different than at least one other receiver antenna.

1 26. (Currently Amended) The wireless communication system of claim 23, ~~further~~
2 ~~comprising a receiver that is connected to the receiver antennae, the receiver including~~
3 electronic circuitry ~~for estimating a~~ to estimate the channel matrix that represents ~~a~~ the
4 transmission channel between the transceiver antennae and the receiver antennae,
5 wherein the means for setting the transceiver antenna polarization of each transceiver

6 antenna is responsive to the electronic circuitry ~~minimizing a singular value spread of the~~
7 ~~channel matrix.~~

1 27. (Original) The wireless communication system of claim 25, further comprising
2 means for setting the receiver antenna polarization of each receiver antenna to optimize
3 separability of the received data streams.

1 28. (Original) The wireless communication system of claim 27, wherein a transmission
2 channel between the transceiver antennae and the receiver antennae is estimated with a
3 channel matrix, and wherein the means for setting the receiver antenna polarization of
4 each receiver antenna comprises minimizing a singular value spread of the channel
5 matrix.

1 29. (Original) The wireless communication system of claim 25, further comprising
2 means for setting the receiver antenna polarization of each receiver antenna to optimize
3 de-correlation of the received data streams.

1 30. (Original) The wireless communication system of claim 29, wherein a transmission
2 channel between the transceiver antennae and the receiver antennae is estimated with a
3 channel matrix, and wherein the means for setting the receiver antenna polarization of
4 each receiver antenna comprises minimizing a correlation coefficient of the channel
5 matrix.

1 31. *Please cancel claim 31 without prejudice.*

1 32. (New) A wireless communication system of claim 23, wherein the means for setting the
2 transceiver antennae polarization resides within the receiver.

1 33. (New) A method comprising:
2 receiving a plurality of signals from a remote transmitter, the remote transmitter
3 transmitting the plurality of signals from two or more transceiver antennae, wherein at least one
4 transceiver antenna has a different polarization than another transceiver antenna;
5 developing a channel matrix representation of a transmission channel that includes at
6 least a subset of the plurality of received signals; and
7 determining an improved polarization for at least a subset of the transceiver antennae to
8 reduce a singular value spread in the developed channel matrix.